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## FINAL REPORT

Engineering Design, Fabrication,  
Installation, Operation, and  
Maintenance Services in Support of  
Research on Laser Plasma Physics

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**Engineering Design, Fabrication, Installation,  
Operation, and Maintenance Services in Support  
of Research on Laser Plasma Physics**

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**Prepared for:** Naval Research Laboratory  
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## **Introduction**

The Plasma Physics Division of the Naval Research Laboratory (NRL) is involved in several projects related to the production, acceleration, and physical properties of high-energy, high-current electron beams. At the core of this effort is the modified betatron project. The goal of the modified betatron project is to accelerate a 1 kA electron beam to an energy of 50 MeV. The research program centers on the critical physics issues associated with this goal, such as beam stability, self field effects, image forces, and injection and extraction processes.

The modified betatron accelerator (MBA) is a large and complex facility. Several high-energy storage capacitor banks and pulsed power systems, with the associated distribution and coil systems, are required to create the various magnetic fields for acceleration and beam confinement and to supply the beam. In addition to the electrical components, the structural framework to support the betatron chamber must allow for precision positioning of the various coils and yet be able to withstand considerable forces and torques during a shot. Because of this complexity, an extensive amount of mechanical and electrical engineering is required to modify and/or fabricate new parts for the betatron.

## **Engineering Support**

Under contract N00014-92-D-2000, SFA provided engineering support for the MBA project to the NRL Beam Physics Branch and by performing the following tasks:

- Provided preliminary engineering layouts and modifications for the various high-power microwave sources and laser plasma physics;
- Provided preliminary engineering layouts and modifications for the various high-power coherent radiation sources and laser plasma physics; and
- Reconfigured the feeds of the 12 resonant coils in the modified betatron to operate at a peak voltage as high as 55 kV.

### ***Preparation of Preliminary Engineering Layouts***

In cooperation with government scientists, SFA provided support to conceptualize research equipment that satisfied the structural, mechanical, electrical, vacuum, magnetic, electrostatic, cost, and schedule requirements of the project. SFA personnel prepared layout drawings, performed analyses for such properties as strength and deflection, and prepared modified drawings for the various high-power microwave and coherent radiation sources and for laser plasma physics.

### ***Reconfiguration of Components of the Modified Betatron Accelerator***

SFA personnel reconfigured the feeds of the 12 resonant coils in the modified betatron to operate at a peak voltage as high as 55 kV. The high voltage driver was connected to the coils with four RG-213 cables. To reduce the amplitude of the field error at the beam orbit, the loop at the input of the coils was kept as small as possible.